this series the patients were younger and presented with lower mean cardiothoracic ratios than in the series of Chauvaud and colleagues.[15]

The Danielson operation, despite some technical modifications, remains highly associated with the need for TVR. Kiziltan and coworkers[4] reviewed their series of 323 patients with Ebstein's anomaly, with TVR performed in 158 (48.9%) patients. In regard to long-term results, they found that the freedom from bioprosthesis replacement was 97.5% ± 1.9% after 5 years and 80.6% ± 7.6% after 10 years. They also found no statistically significant difference at 10 and 12 years in freedom from reoperation after TVR compared with freedom from reoperation after TV repair. These good results, according to the authors, might be related to the large size of bioprosthesis that can be implanted relative to patient somatic size and to the normally low right ventricular systolic pressure in patients after Ebstein's anomaly repair. However, these results are for a limited period and do not rule out the ultimate need for tricuspid prosthesis replacement and therefore do not decrease the importance of creating an efficient and durable TV repair operation.

The indications for surgical intervention in patients with Ebstein's anomaly remain controversial in asymptomatic patients, although the natural history of the disease is a relentless progression to congestive heart failure, arrhythmias, or both[16,17] in the majority of patients not undergoing operations. Mortality for these late-stage complications is high.[18,19] It seems also to be true that surgical treatment at late stages has less chance of reversing the ravages of the disease completely. That might be the case in 1 early death and another late progression to heart failure in this series. These events seem to be related to the state of the 2 patients who had left ventricular myocardiopathy preoperatively rather than to the surgical technique. This further reinforces the notion that surgical intervention should come earlier, before deterioration of right and left ventricular function.

In conclusion, this surgical technique that reconstructs the TV in a cone shape, which results in a central flow through the tricuspid orifice and a full coaptation of the leaflets, can be performed with low mortality and morbidity. Early echocardiography showed significant reduction in tricuspid insufficiency, and the follow-up showed clinical improvement in the majority of patients, low incidence of reoperations, and no need for TVR. Further studies and longer follow-up are required to evaluate the behavior of the TV and RV after this procedure.

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Discussion

Dr Jan M. Quaegebeur *(New York, NY)*. Dr da Silva, I would like to congratulate you on the presentation of an ingenious technique. It is interesting to note that although Ebstein's anomaly is a very rare condition, there have been 3 presentations dedicated to this anomaly in this meeting. Therefore the quest for a better repair of Ebstein's anomaly continues. You have described your experience over 10 to 12 years with an innovative technique, which tries to improve TV function by realizing a complete coaptation between valvular tissue in comparison or in contrast with the previous repairs by all of us that relied on a monocuspid or bicuspid valve where the coaptation is between the valve leaflets, namely the anterior and posterior leaflets, and the ventricular septum. Forty patients were presented with a low early mortality rate and only 1 late death, which are very good results.

I am not entirely clear about the age of your patients. You said that the mean age was 16.8 years, but I would like it if you could answer briefly how many patients were less than 10 years of age, for instance.

Dr da Silva. Well, the youngest in this series was 22 months old, and the oldest, I think, was 49 years old. Afterward, we had more patients, and among them there was a 3-month-old girl who underwent repair with this technique.

I will say that we have 16 patients younger than 13 years. Therefore 24 patients were older than that age. But I think it is better to use this technique in younger patients, especially those less than 18 years of age.

Dr Quaegebeur. You have provided me with the article and beautiful illustrations, I must say. It happens that last week I had a patient on the schedule with Ebstein's anomaly, and therefore I said, well, we will see how we can maybe improve the technique because, theoretically, it would be better to have coaptation between leaflet tissue than with leaflet tissue and septal tissue. Invariably, in our experience the residual tricuspid incompetence is at the level at which you have absent leaflet tissue. Therefore the concept, I think, is very sound.

This patient had muscularization of the posterior leaflets, which happens quite often. There was absolutely no leaflet tissue at the level of the septum. You have described the attachment of the anterior leaflet at the level of the anteroseptal commissure like a bit of fibrous continuity before it reaches the papillary muscle of the anterior leaflet. This patient did not have such an attachment. In my experience, I could not perform this technique.

There is a great variability in the morphology of the valve in Ebstein's malformation. My question is this: Are you always able to perform this technique, or are there patients in whom you do something different?

Dr da Silva. Well, in the type D of Carpentier's classification, I think we have to go to valve replacement. I also think that in older patients, if you have difficulty finding tissue enough to construct a good tricuspid valve, it is good to indicate valve replacement or the Carpentier or other repair technique if possible. But in my experience, all cases were done with this technique. If you push to it, you can do a lot of maneuvers that can compensate for having little tissue. One of them is to take down the posterior leaflet from its attachment without support and then get the support for that leaflet at the septal tissues. You can have some residual, malformed septal leaflet that can be useful as a subvalvular support for the posterior leaflet. And with that I think you can reconstruct the cone the way I did many times. Actually, I have movies on those patients, in many situations, that can be handed to people if they want; they show many variations of the technique. Anyway, I agree that in complex situations sometimes it might be better to replace the valve.

Dr Quaegebeur. The next question is with regard to your echocardiographic evaluation. The distance between the posteroseptal commissure and the anteroseptal commissure in patients with Ebstein's anomaly is sometimes quite large. Now the reduction of the tricuspid annulus is mainly done in the part where you have a very thin atrialized portion of the right ventricle. The area of the septum is very difficult to plicate. Therefore if you have to bring the posterior leaflet back to the anteroseptal commissure, you really have to reduce the annulus posteriorly quite significantly.

The question is this: Do you have any data about the tricuspid annulus postoperatively compared with during the normal disease course in terms of the possibility of creating an atrial cuspid annulus that is too small?

Dr da Silva. Well, we have done echocardiography on the hospital discharge day, usually on the 10th postoperative day, and we have measurement of that annulus. Actually, there is a reduction of its anteroposterior diameter of about 50%, compared with the preoperative diameter.

Now regarding the *z* score, we do not have those data, but we have compared with the mitral annulus.

Right now, we are in the process of re-evaluating these patients. If you take the first girl on whom we operated, she required reoperation. But now, 13 years from the operation, her tricuspid annulus is already greater than the mitral valve.

We had 2 cases in which we had gradient across the TV that was concerning to me, but then with time the annulus had grown, and that gradient went away.

Importantly, we did not have any case of permanent tricuspid stenosis. But I think that is a good idea. We have all the cases being studied, and we still can compare with the normal *z* score for sure.

Dr Quaegebeur. Finally, you have a few patients in whom you have had to reintervene because of failure. Do you know the mode of failure? What happened to these reconstructions?

Dr da Silva. Thank you for yours remarks and questions. Regarding the reoperations, the first girl of this series had dehiscence in the septal area of the valve. Another patient who had Wolff-Parkinson-White syndrome came back with a tear in the valve. We usually try to cut the abnormal accessory pathway surgically, but in that case we could not accomplish that, and the patient underwent many sessions of catheterization, trying to do catheter ablation of that abnormal conduction pathway.

Recently, a month ago, we had to reoperate on another patient; the first operation was done 20 years ago, when he was 7 years old. Again, there was a dehiscence at the level of the septum. Therefore because of that concern, we are now placing at least 8 stay sutures that are interrupted. Then we run around the annulus, reinforcing it with a medium-term absorbable suture. We are concerned about those types of dehiscence, which are very possible.

Dr Joseph A. Dearani (Rochester, Minn). I think Dr Quaegebeur pointed out a number of important points, and the most important one is that every patient with Ebstein's anomaly is different. We have seen many patients with Ebstein's anomaly over the years, and I have learned a lot from all of the techniques that have been described. I think the lesson and the message for surgeons who see patients with Ebstein's anomaly is to remember the value of these various repair techniques and then incorporate aspects of different repairs when you are confronted with a particular situation.

I have learned from my practice over the years that a severely dilated right ventricle on the other side of a tricuspid repair can compromise the integrity and durability of that repair over time. There have been situations where the postbypass transesophageal echocardiogram looks very good in the operating room, and then 5 or 7 days later, the dismissal echocardiogram shows a greater degree of tricuspid regurgitation. You are then confronted with the situation of deciding whether to accept it and know that they are going to be back sooner than you would like or whether you return to the operating room to revise the repair or replace the valve. An

important adjunct to the operation that I have started to do was introduced by Dr Sano. This involves resecting a portion of the RV to reduce its size. I now resect the inferior wall of the RV between the acute margin and the posterior descending coronary artery and parallel to the right coronary arterial branches, and therefore coronary artery compromise is eliminated or minimized. I think anything to reduce the size of the large atrialized RV on the other side of the tricuspid repair will help in the long term. I congratulate you and the authors and look forward to the opportunity to apply some of your techniques.